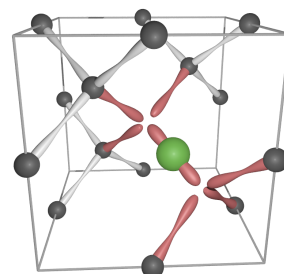


Fundamental defect properties in diamond for quantum technologies

Exceptional technological progress in diamond means that it is now at the forefront of many quantum technologies. For instance, diamond-based sensors can detect the magnetic field of a single atom and determine precisely what and where it is; or probe the fundamental nature of our universe to test theories of quantum gravity.

These amazing capabilities are enabled by “point-defects” – atomic-scale “faults” formed by displacing, replacing, and/or removing carbon atoms – within the diamond structure. Different point defects have different properties: the defect formed by a nitrogen atom next to a missing atom (called the “negatively charged nitrogen-vacancy centre”, NV^-) is currently the world’s highest-spatial-resolution magnetic field sensor [1,2]; the “neutral and negatively charged silicon-vacancy centre”, $\text{SiV}^{0/-}$ [see right for cartoon], is a leading platform for next-generation quantum communication networks [3–6].



The performance of diamond in any quantum technological application depends on understanding of both the underlying material, and the properties and mutual interactions of the precursor defects (e.g., vacancies, interstitials, substitutional defects). As diamond technologies mature, precise control over all these aspects is absolutely crucial.

This project will exploit recent developments in material synthesis combined with novel defect generation and control methods to enable us to characterise and subsequently control defects at unprecedented levels. The project will combine Warwick’s world-leading understanding of diamond point defects and their spin properties with advanced defect generation and optical spin control [7,8]. It is anticipated that this work will result in the identification and characterisation of existing and new functional point defects, with potential quantum technology applications dictated by their functional optical and spin properties.

The research will be carried out in the UoW Physics Department, and will involve but is not limited to:

- identification and characterization of novel color centers using cryogenic optical and magnetic resonance techniques;
- understanding of defects’ electronic properties to deduce their chemical constituents and atomic configuration;
- novel defect generation and diffusion control to optimize the properties of these defects

Capabilities at Warwick are enhanced by close collaboration with international academic and industrial partners who provide access to state-of-the-art material and unique facilities. For further details please contact Dr. Ben Green: b.green@warwick.ac.uk.

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